

Title: NATURE OF THE NEARER ASIA LOW-PRESSURE REGION (T. A. Sarymsakov, et al)
(USSR)

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CHARACTER OF THE NEARER ASIA LOW-PRESSURE REGIONI. A. Saryasakov, et al.
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As evidenced by the charts of the monthly mean atmospheric pressure distribution, a region of lowered pressure emerges in summertime over the Asian continent. This region of lowered pressure is subdivided into separate centers known as the thermal depressions. In general, the reason for the emergence of summer depression is the warm-up of the continental air mass and its diminution due to outflow of continental air toward the ocean [about 1 ton for 1 square meter of surface (¹)/]. Study of the role played by this so-called anti-monsoon current in the explanation of the climatic picture of pressure distribution is contained in the researches of Y. V. Sholuykin and his students.

Theoretical studies dealing with the transport of air-masses and the formation of depressions assume either a simple model of a round sea surrounded by continents, or a round continent surrounded on all sides by infinite oceanic expanses. Therefore the low pressure region is as symmetrical about the origin of coordinates as the summer region of the maximum overheating; while in wintertime the high pressure region coincides with the region of maximum cooling. Actually, the process of formation of the thermal depression is much more complex than the following example of formation of the Nearer Asia depression.

By the Nearer Asia depression is meant that portion of the summertime low pressure region which develops over Nearer Asia. On the mean-monthly pressure charts the basic center of this depression is located over Baluchistan, and is, therefore, shifted east relative to the regions of maximum warm-up of the air masses, over the Arabian, Iranian and Middle Asian deserts.

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examination of the schematic thermobaric field which causes the formation of thermal depression (Figure 1) discloses that the thermal field is characterized by the following:

a. A source of heat in the form of a heat crest or nucleus on the chart σ_{1000}^{500} over Iran, as determined by the mass-up of air masses over the coasts of Arabia and Iran.

b. A source of relative coldness in the form of a cold trough or nucleus on the chart σ_{1000}^{500} over the Arabian Sea and Southern India, and due to the relatively cold monsoon air-masses.

c. Relatively cold sources over the coast and the Mediterranean Seas and Eastern Kazakhstan.

The heat nucleus over Arabia and Iran leads to the formation there of a high altitude anticyclone or crest, the center of which is located over the western part of the depression.

The nuclei of relative coldness to the east and west from this anticyclone in the baric field are represented by troughs. The center of depression at the earth's surface is located beneath the delta of the high altitude frontal zone, formed by the eastern periphery of the high altitude anticyclone and the trough over Eastern Kazakhstan.

The thermal structure of the frontal zone is characterized by a latitudinally extended thermal crest over Baluchistan and Sind, produced by the heated air masses. This configuration of thermobaric field, characteristic of the initial stages of depression formation, creates a region of the dynamic pressure fall (3) and places the center of depression under the delta of the high altitude frontal zone. To illustrate, in region 1, figure 1, the divergence of the isohypses ($\text{hms} < 0$) at $E < 45$ degrees causes a dynamic drop in pressure. The advective increase in pressure caused by the advection of cold ($E > 0$) is small since the angles E are small (advective variation in pressure being proportional to $\sin E$) and the

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dynamic drop in pressure predominates. In the region 2, the advection of cold ($E > 0$) is displaced by thermal advection ($E < 0$), and, consequently, the advective increase is displaced by the advective drop in pressure, which adds to the dynamic drop in pressure caused by the factor as in region 1; i.e., by the divergence of the isohypses ($H_{ms} < 0$) at $/E/ < 45$ degrees. There actually takes place a maximum drop in pressure forming the center of the depression.

Figure 1: The thermobaric field of the Ussuriysk depression.

Thin solid lines represent the isohypses of absolute topography at the 700 millibar surface; thick lines represent the sea level isobars; dotted lines represent the isohypses of relative surface topography 500 over 1000 millibars.

The divergence of air masses is intensified by the orographic influence of the Middle Asian mountain ranges located in a generally latitudinal direction. These mountain ranges prevent the air currents in the lower 3-4 kilometer layer over the eastern part of the Middle Asia from anticyclonic southern deviation.

A powerful branch of these currents is deflected east and northeast by the Tien-Shan mountains. Further south, in region 3, where $/E/ < 45$ degrees, the divergence of the isohypses ($H_{ms} < 0$) causes a dynamical increase in pressure, which is, however, weakened by the intensive advection of heat. Due to this increase in pressure at the earth's surface, an increased baric gradient is observed in the southern part of the depression. However, the depression, once having formed, cannot remain stationary, in view of the appearance of the advective-dynamic circulation mechanism which constantly transforms the spatial thermobaric fields in such a way as to produce closed periodic cycles in the development and decay of the depression.

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The appearance of the depression is connected with the development of a thermal high altitude anticyclone of the depression, further development of the depression being dependent on the evolution of the anticyclone, which in turn is determined to a large measure by the processes taking place at the northern periphery of the anticyclone.

Assuming, for simplicity, that western currents are being observed over the European USSR, then the anticyclonic circulation at the western periphery of the high altitude anticyclone (figure 1), producing thermal advection and a warm crest over the Karakums, together with the cold advection over the Volga and the southern Ural regions, facilitates the severance in this region of a new high altitude frontal zone.

Thus, immediately north of the regions of maximum heating of the air masses there is created a region of ~~the~~ dynamic increase of pressure, which causes the deformation of the initial thermobaric field and also causes the intensification and spreading in the northern direction of the anticyclone B. This, in turn, by increasing the meridionality and divergence at the eastern periphery of the anticyclone, deepens the depression, leading to the formation of its northernmost portion -- the Middle Asiatic depression. This deepening process continues until the intensification of the crest over Southern Kazakhstan, and the deepening of the troughs over Caucasus and Tadzhikistan bring about the severance of the crest over Kazakhstan as well as a latitudinal cyclonic transformation, as a result of which the depression is filled in by cold westerly air masses.

The described process represents the basic geographically connected summertime process over the Nearer and Middle Asia in the presence of westerly transport over northern regions. This process can be materially complicated by the transformations of the adjacent thermobaric fields, which will not be discussed herein. The formation and deepening of the Nearer and Middle Asia depressions is facilitated by the orography

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of the eastern regions of Middle Asia, the effect of which briefly is as follows: the northern and northwestern meridional currents of the eastern periphery of the anticyclone B are affected by the dynamic uplift as well as by the delay in cold advection and also by the local increase in the horizontal temperature gradient over the northern slopes of mountain ranges, by the formation of dynamic troughs and by the local decrease in the horizontal temperature gradient over the leeward slopes of mountain ranges -- all of which deepen the depression.

Thus, summarizing all of the above-mentioned, it is possible to state that thermal factors responsible for the formation of the general low pressure pattern create at the same ^{time} initial thermobaric fields, which, in view of the appearance of the advective-dynamic mechanism, cause the formation of thermal depression.

The confirmation of the validity of this mechanism must be sought in detailed climatological charts of the world, since, according to the above theory, the center of the low pressure region must appear east of the zone of maximum warm-up of air masses by the underlying surface.

References cited:

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